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METHODS TO FINANCE THE WORK OF THE ACADEMIES[1]

By Professor GEORGE E. JOHNSON

KANSAS STATE COLLEGE, SECRETARY OF THE KANSAS ACADEMY OF SCIENCE

THE main aim of an academy of science is generally the stimulation of interest in science by the holding of at least one annual meeting for the presentation of scientific papers. Of second importance, but almost as necessary as the programs is publication. The knowledge that good papers may be published is a strong stimulus for their preparation for the academy program and aids greatly in securing and holding a satisfactory membership. Other worthy projects, each maintained by one or more academies, are: (1) the raising of an endowment fund for research, (2) holding essay contests for high-school students, (3) publishing nature booklets, (4) holding field trips, (5) providing popular lectures on science, and (6) maintaining a scientific library. This paper deals with the problem of financing the academy meetings and publications. Since membership dues usually cover more than the expenses connected with the presentation of programs at the meetings (such as postage and printing costs for program, stationery, bills and notices) the most important question before us is that of financing an academy publication. I wish to acknowledge with thanks the provision of information for this paper by the representatives or secretaries of twenty-two other academies. It appears that academies which have adequately financed their publications have been able to do so largely through some form of state aid. Four states provide legislative appropriations for academy printing: Illinois, $2,000; Indiana and Iowa, each $1,500; Wisconsin, $1,000, recently reduced from $1,500. Some other academies receive free printing from some state educational institution. The Michigan publication is financed and published by the library of the state

[1] Read at the New Orleans session of the Academy Conference, American Association for the Advancement of Science, December 28, 1931, and at the McPherson meeting of the Kansas Academy of Science, April 15, 1932.

university, which has put out two large volumes a year, at an annual expense of around $10,000. Exchanges are received and kept by the university library. In Ohio the university contributes annually $1,000 towards the publication of the *Ohio Journal of Science* and pays postage on it. In Oklahoma the university and the A. and M. College print the *Proceedings* of the Academy. In West Virginia, the printing is done by the university. In North Carolina the university pays each year $2,500 and the academy $300, to finance the *Journal of the Elisha Mitchell Scientific Society,* in which the *Proceedings,* abstracts and many papers of the academy are published. In Kansas, three state schools furnish $500 a year, and in Nebraska a new arrangement is just going into effect whereby the university will buy 100 copies of the *Transactions* for $100. In most of these cases the library of the academy is deposited in the supporting institution, or in the state university if the money is appropriated by the legislature.

This paper was probably requested for this session of our conference because the Kansas Academy has been struggling with this problem, and a brief account of our partial solution may be interesting and perhaps helpful to academies that receive no form of state aid. The Kansas Academy of Science received free publication at the hands of the state printer, by legislative appropriation, soon after its organization in 1868, and a library was built up at the State House in Topeka. Some disagreement between the secretaries of the academy and of the state historical society led to the removal of the academy library to the university about 1918, and probably was instrumental in bringing about the loss of state aid in 1922, when reference to the academy was dropped in the recodification of the laws. Publication was discontinued in 1922, and the academy consequently decreased in size and activity till 1928, when it was voted to publish at the expense mostly of the authors. A volume of 281 pages was then put out, the authors paying $2.50 a page toward the cost of their papers. While this volume was under way, the university agreed to pay $500 for 500 copies, with which to continue the academy exchanges. This arrangement was renewed for the following year, but it was then discontinued. Although the academy felt little need for a library of its own, it considered its exchanges as representing great value to some of the state schools, but neither the university nor any of the other state institutions could purchase the four or five thousand volumes of these, which were then owned by the academy. It was eventually agreed, however, that the academy library should be divided among the university, the state college and one of the teachers colleges, in the ratio of 2:2:1. Now the academy receives from these three institutions $500 a year in the same ratio, and each of the institutions receives its proportionate share of 500 copies of the *Transactions* annually, with which to make exchanges. This arrangement is for ten years and the academy hopes that it will be renewed. It is thus possible to print an annual edition of about 1,000 copies, each containing about 200 pages. Last year the $500 received from the three institutions cared for about 80 per cent. of the cost of a book of 184 pages, but this year it cared for only half the cost of a book of somewhat over 300 pages. Next year it will be necessary to reduce the number of pages in the annual volume, or else authors will have to contribute more than the cost of their reprints. As is well known, the cost of printing varies greatly among different firms. This year an edition of 1,000 copies cost only $2.70 a page, this low figure being given to the academy by a job printer in a small city. Eight-point type was used for the scientific papers and six-point for the business proceedings.

I wish to devote most of my remaining time to a discussion of academy dues. For an inadequately financed academy it is well for membership dues to cover more than just the running expenses; that is, they should be made to aid publication, field trips, essay contests, etc., if at all possible. The question arises as to how high dues may be to give considerable revenue to the academy and still not be excessive or unfair. In 11 academies the annual dues are $1.00, in 8 they are $2.00, in 2 they are $2.50, and one (St. Louis) has dues of $3.00. Four states (Kentucky, Nebraska, Virginia and Wisconsin) make a reduction of 50 cents from their dues to those of their members who are members of the American Association. The Kansas Academy has dues of $1.00, with 282 members in 1931. We have felt that dollar dues were conducive to a larger membership. The same idea is apparently held by the four larger academies (Indiana, Michigan, Illinois and Iowa), with paid-up memberships around 900 in the first three and about 500 in the last. However, five other academies (Colorado-Wyoming, North Carolina, Pennsylvania, Tennessee and Virginia) each have $2.00 dues, with about half the membership of the largest academies. It is thus suggested that dues of $2.00 do not keep many people out. The Colorado-Wyoming Academy, with membership of 190, collects about $100 more from dues than does the Kansas Academy, with nearly a hundred more paying members. Wisconsin has just changed its dues from $1.00 to $2.00, with a 50-cent reduction to members of the American Association.

The highest dues of any state academies are $2.50, for the Ohio and the Kentucky Academies, but the latter reduces them to $2.00 for members of the American Association. The Ohio Academy has 525 members, about 400 less than in each of the neighbor-

ing academies of Indiana, Michigan and Illinois. Nevertheless, it collects $1,300 annually, about $400 more than any other academy. The secretary of the Ohio Academy assures me that the dues do not keep people out of the academy. The Kentucky Academy, with dues of $2.50, has a membership only 40 per cent. as large as that of the Tennessee Academy, with $2.00 dues. I believe that dues of $2.50 are too high for most academies. I am inclined to think, however, that an academy providing its members with a fair-sized publication may well have dues of $1.50 to $2.00. When no publication is given to members, I do not think an academy should have dues of more than $2.00.

I do not favor any reduction of academy dues to members of the American Association. Such members are usually the most interested and demand no bargain price, but count it a privilege to support the academy. The reduction makes confusion in billing and recording. The change from 50 cents to $1.00 for A. A. A. S. members of the Kansas Academy, I am sure, kept no one from joining the academy.

At least three academies charge an initiation fee of $1.00, and the Illinois Academy has an annual income of $200 from this source. New Hampshire has an initiation fee of $2.00. There appears to be no evidence that an initiation fee of $1.00 holds back any one who wishes to join. On the other hand, this requirement probably helps to hold members who might drop out at the end of a year. A $2.00 initiation fee is probably too high for most academies.

The annual academy allowances received from the American Association (50 cents a year for each member of both organizations) range in amount from about $25 to about $170. One of the affiliated academies (Maryland) does not take the allowance. Eleven consider that a discontinuance of the allowance would seriously handicap their work. Five failed to answer an inquiry on this point, or were not sure, and four of the smaller academies did not think their work would be injured if the allowance were not received. Although the allowance is certainly a real help to academies that do not have state aid, yet I think it would be well for each academy to try to devise means for adequate support from other sources, so as not to be seriously embarrassed if the association should find it impossible to continue the allowances.

Life membership fees in the academies vary from $15 to $100, being usually between $25 and $50, paid at one time. Only in the Kansas Academy and in the Tennessee Academy are former dues credited towards life membership. In the Kansas Academy the life membership fee was recently increased from $20 to $30, but most of the life memberships have been secured by the payment of annual dues for 20 years. While life memberships may in some cases be a burden to an academy, if the fee is low and life members receive the academy publication free, they might yield considerable income if the fee were collected as a single payment and placed in an endowment fund.

The St. Louis Academy receives an annual income of about $1,200 from endowment and rents. The Virginia Academy has a permanent fund of $9,000, the proceeds of which are used to aid research. Several academies have savings that yield annual incomes of from $150 to $175. Endowment may well become an important source of income for academies in the future. Bequests by members and others might be encouraged.

Some revenue may sometimes be secured by academies from the sale of current volumes of their publication to libraries and non-members, and also from the sale of complete sets. Such sales were reported by a number of the academies represented in this conference.

Another source of income to academies, thus far almost untouched, is the sale of reprints from the academy publication at above their actual cost. Each author would usually purchase a number of reprints of his article, and important contributions might sell otherwise. We pay 50 cents a page for 200 reprints in Kansas. Our first year we charged each author $2.50 a page, which covered most of the cost of that volume of the *Transactions,* a book of 281 pages. Since then we have sold the reprints at almost cost plus half the price of the cuts. A charge of 75 cents or $1.00 a page for 200 reprints may prove to be quite feasible.

THE TEMPLETON CROCKER EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES

By G. DALLAS HANNA

CALIFORNIA ACADEMY OF SCIENCES

THIS expedition sailed from San Francisco on the yacht *Zaca,* under the direction of Mr Crocker and under the auspices of the California Academy of Sciences. The interval between March 10 and September 1, 1932, was spent in making zoological and botanical investigations from San Francisco south as

far as the Galapagos Islands and return. The entire cruise covered 9,046 miles.

The primary object of the expedition was the making of detailed collections in the Galapagos Islands, with particular attention being paid to botany, ichthyology and ornithology. The members of the party were highly successful in these branches, having reached such difficult localities as the rain forest at the top of Indefatigable Island; apparently no previous expedition had succeeded in reaching that point.

On the way to and from the Galapagos, visits were made to various places on the west coast of Mexico and Central America and also Cocos Island, the Tres Marias Islands, the Revillagigedo Islands, Cedros Island, Guadalupe Island and San Nicolas Island.

Dredging stations were occupied at 168 localities and much attention was given to this method of collecting. A wealth of material was obtained at some of the most celebrated localities of western America, such as Cape San Lucas, Acapulco, Gulf of Fonseca, etc. Many of the stations were located where no previous work had been done. The greatest depth which was reached by the equipment was 250 fathoms.

The ship was provided with tanks for transporting fishes alive, and 331 specimens were brought from tropical waters for exhibition in the Steinhart Aquarium. About one third of the total catch was kept aboard successfully for over five months.

The California Academy of Sciences was represented by Mr. Harry S. Swarth, ornithologist, Mr. Robert J. Lanier and Mr. H. Walton Clark, marine zoologists, Mr. John Thomas Howell, botanist, and Mr. Maurice Willows, entomologist. Mr. Toshio Asaeda accompanied the expedition as artist and photographer and, under Mr. Crocker's personal direction, made over 200 water color paintings of fishes, crustaceans and other marine life; he also took 1,300 still pictures. Dr. Albert E. Larsen, physician, paid special attention to the making of plankton collections for the University of California. Captain Garland Rotch was largely responsible for the construction and operation of the dredges and trawls and took several thousand feet of motion-picture film. All members of the crew joined whole-heartedly in the manifold duties of such an expedition, and much of the success attained is directly attributable to this cooperation. Mr. Crocker became general assistant in all activities where help was needed.

The manner in which this expedition was organized and conducted affords an excellent example of converting what ordinarily might be a pleasant but prosaic yachting trip into a cruise which yielded results of great interest and permanent scientific value. After all, much of the future exploration of the ocean and oceanic islands must necessarily be done by such men who have the means and the interest to carry out similar projects successfully.

Preliminary statements regarding the collections obtained have been furnished as follows by the curators of the various departments of the academy.

Botany: About 3,000 specimens of plants (not including duplicates) were obtained. Some species of flowering plants from the Galapagos had not previously been collected since the visit of Charles Darwin in the *Beagle*. Over 100 specimens of cacti were obtained, 40 of which are from the Galapagos; these latter are expected to serve as a basis of a critical study of the species found there. Over 200 species of marine algae were obtained at the Galapagos, and additional large collections were obtained from Lower California and other places where dredging was done. A large number of Hepaticae with smaller numbers of mosses and fungi were obtained in the tropical rain forests of the Galapagos Islands and Cocos Island.

Entomology: Although no trained entomologist accompanied the expedition, a very considerable number of insects was taken by the staff, mostly by Mr. Maurice Willows, who was assigned to this duty by Mr. Crocker. The collections of Hemiptera and Diptera from the Galapagos are of special interest because these groups were largely neglected by the academy's expedition of 1905–1906.

Fishes: A very large collection of fishes was obtained by all the usual means employed in such work except explosives. Special attention was paid to tide pools and the use of a submarine light. Some excellent species were obtained in deep water with the dredges and trawls.

Herpetology: Since most of the localities visited had been previously explored by herpetologists, less attention was given to this branch of study than some others. However, a snake was obtained on Duncan Island of the Galapagos, the second ever taken there. Several sea snakes were taken along the Central American coast.

Paleontology: Fossils were obtained on Clarion Island of the Revillagigedo Group for the first time. Except for one brief note, this island was previously supposed to be wholly volcanic. Fossils were also collected at several points in the Galapagos Islands at localities additional to those which were made known by the academy expedition of 1905–1906. The large amount of dredging which was done resulted in the bringing together of a huge collection of marine shells. Excellent specimens of *Xenophora* were obtained along the Central American coast; the genus has apparently hitherto been obtained but once from western North America. Five specimens of a striking jet black *Mitra* (not *belcheri*) fully five inches long were dredged off the coast of Lower California.

Brachiopoda, Echinoidea, Asteroidea, sponges, corals and many Crustacea were collected in large numbers and at many places.

Aquarium: The tanks on the deck of the *Zaca* were equipped for constant circulation of sea water. By means of heating apparatus it was possible to bring the tropical forms alive from as far south as the Galapagos to San Francisco. Many of the gaudily colored fishes from warm waters seem to lose some of their brilliance when placed in the aquarium, although otherwise they appear normal in every way. Except for the anxiety caused by the possible failure of the water circulation system the transportation of living fishes aboard ship involves no very great difficulty and apparently imposes no special hardship on the fishes themselves. Those carried on the *Zaca* consumed 640 pounds of food during the cruise.

Ornithology: A collection of about 400 specimens of birds was brought back by the expedition. By far the greatest number was taken on the Galapagos Islands where special effort was made to select certain species or particular plumages to fill out the academy's series. One species of finch not known since the time of Charles Darwin and supposed to be extinct was found to have survived on some of the islands. The birds of these islands are of exceptional interest, not only because of their many remarkable peculiarities, but because the study of them was largely responsible for the formulation of Darwin's theory of evolution. By the use of the freezing equipment installed aboard the ship, Mr. Crocker was able to bring back numerous birds in the flesh. These were taken after the departure of the ornithologist.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

HOTEL HEADQUARTERS AT ATLANTIC CITY

THE ninety-first meeting of the association will be held at Atlantic City from Tuesday, December 27, to Saturday, December 31. This will be a quadrennial convocation meeting, which would normally have been held at Chicago. A meeting in Chicago was, however, postponed until June in order to cooperate with the Century of Progress Exposition. Forty-one scientific societies plan to hold meetings with the association at Atlantic City. Several societies will meet for the first time with the association. Others, which have not met with the association since the New York meeting of 1928, will be present at Atlantic City.

Dr. Franz Boas, retiring president of the association, will deliver the opening general address on a subject in anthropology. The first Maiben Lecture, a new lecture established in memory of the late Hector Maiben, of Lincoln, Nebraska, will be delivered by Dr. Henry Norris Russell, of Princeton University, on "The Constitution of the Stars." Dean Dexter S. Kimball will deliver an evening address on "The Social Effects of Mass Production." Other general addresses will be given by Dr. O. H. Caldwell, formerly U. S. radio commissioner, Dr. Dayton C. Miller, Dr. Mel T. Cook, Dr. Richard C. Tolman (Gibbs Lecture), Dr. Russell W. Bunting and Dr. C. C. Speidel. Practically all the fifteen retiring vice-presidents of the association will deliver addresses of somewhat general interest.

A number of sections and societies are planning important symposia. Dr. John J. Abel, president of the association, is organizing one for discussion of "The Physiological Relations of the Pituitary Body." Sections K (Economics, Sociology and Statistics) and M (Engineering) are organizing a symposium on "The Stabilization of Employment." Further details about symposia and meetings of societies and sections will be given in subsequent numbers of SCIENCE.

HOTEL HEADQUARTERS

General headquarters for the association will be at Chalfonte-Haddon Hall, which is located on the board walk. Rates quoted for rooms, single occupancy, American plan (with meals), are $5.00 to $9.00 without bath and $7.00 to $10.00 with bath. For single occupancy, rooms with bath on the European plan (without meals) are listed at $3.00 to $6.00. Rooms with private bath for double occupancy (two persons), are quoted at $12.00 to $18.00, American plan, and $5.00 to $10.00, European plan.

Names of societies holding meetings, dates of meetings and hotel headquarters are given below. The dates for section meetings include the meeting dates of all associated societies. Unless otherwise stated, the hotel headquarters for the societies are the same as for the section under which they are listed. Minimum special hotel rates per person for two in a room, European plan, are quoted. For American plan rates (with meals) add $2.00 to $3.00 extra.

SECTION A (MATHEMATICS): December 27 to 30; Hotel Morton, $2.00 without bath. American Mathematical Society, December 27 to 30; Mathematical Association of America, December 27 to 28.

SECTION B (PHYSICS): December 27 to 31; Ambassador Hotel, $3.00 with bath. American Physical Society,

December 28 to 30; Society of Rheology, December 27 to 28; American Association of Physics Teachers, December 30 to 31; American Meteorological Society, December 27 to 29; Ludy Hotel, $2.50 with bath.

SECTION C (CHEMISTRY): December 29 to 31; Marlborough-Blenheim Hotel, $3.50 with bath. Eastern New York, New Jersey, Pennsylvania, Delaware and Maryland Sections of the American Chemical Society, December 29 to 31.

SECTION D (ASTRONOMY): December 27 to 29; Madison Hotel, $2.50 without bath. American Astronomical Society, December 27 to 29.

SECTION E (GEOLOGY AND GEOGRAPHY): December 27; Ritz-Carlton, $3.50 with bath.

SECTION F (ZOOLOGICAL SCIENCES): December 27 to 30; Ambassador Hotel, $3.00 with bath. American Society of Zoologists, December 28 to 30. Headquarters for the Entomological Society of America, December 27 to 28, and the American Association of Economic Entomologists, December 28 to 30, will be at Chalfonte-Haddon Hall, $2.50 with bath. Headquarters for the American Society of Parasitologists, December 28 to 30, will be at the Chelsea Hotel, $3.00 with bath.

SECTION G (BOTANICAL SCIENCES): December 27 to 30; Traymore Hotel, $2.50 without bath. Botanical Society of America, December 27 to 30; Mycological Society of America, December 28 to 30; American Society of Plant Physiologists, December 27 to 30. Headquarters for the American Phytopathological Society, December 28 to 30, will be at the Madison Hotel, $2.50 without bath.

SOCIETIES RELATED TO SECTIONS F AND G: Headquarters and dates of meetings are as follows: American Society of Naturalists, December 30, Ambassador Hotel, $3.00 with bath; Ecological Society of America, December 28 to 30, Traymore Hotel, $3.00 with bath; American Microscopical Society, December 29, and Genetics Society of America, December 27 to 30, Chelsea Hotel, $3.00 with bath; Phi Sigma Biological Research Society, December 28 to 30, Ritz-Carlton, $3.50 with bath.

SECTION H (ANTHROPOLOGY): December 28 to 30; Marlborough-Blenheim, $3.50 with bath. American Anthropological Association, December 28 to 30; American Folk-Lore Society, December 28 to 30.

SECTION I (PSYCHOLOGY): December 28 to 30; Dennis Hotel, $2.50 with bath.

SECTION K (SOCIAL AND ECONOMIC SCIENCES): December 26 to 28; Chalfonte-Haddon Hall, $2.50 with bath. Econometric Society, December 26 to 28; Metric Association, December 27.

SECTION L (HISTORICAL AND PHILOLOGICAL SCIENCES): December 29 to 30; Ludy Hotel, $2.50 with bath. History of Science Society, December 29 to 30.

SECTION M (ENGINEERING): December 28 to 29; Chalfonte-Haddon Hall, $2.50 with bath. American Society for Testing Materials, December 29; Institute of Radio Engineers, December 29.

SECTION N (MEDICAL SCIENCES): December 28 to 30; Chelsea Hotel, $3.00 with bath. American College of Dentists, December 30.

SECTION O (AGRICULTURE): December 28 to 30; Chalfonte-Haddon Hall, $2.50 with bath. American Society for Horticultural Science, December 28 to 30; American Society of Agronomy, December 28; Potato Association of America, December 28 to 30; Crop Protection Institute, December 29.

SECTION Q (EDUCATION): December 28 to 29; Dennis Hotel, $2.50 with bath. Pi Lambda Theta; Phi Delta Kappa; Kappa Delta Pi.

SCIENCE IN GENERAL: Society of the Sigma Xi, December 28; Chalfonte-Haddon Hall, $2.50 with bath. Gamma Alpha Graduate Scientific Fraternity, December 28 to 29; Ludy Hotel, $2.50 with bath. Sigma Delta Epsilon Graduate Women's Scientific Fraternity, December 28; Marlborough-Blenheim, $3.50 with bath. American Nature Study Society, December 27 to 29; Marlborough-Blenheim, $3.50 with bath. Pi Gamma Mu, December 29; Chalfonte-Haddon Hall, $2.50 with bath.

In general, each associated society will hold sessions in the hotel assigned to it as headquarters. All who expect to attend the Atlantic City meeting are urged to make early reservations. This is especially desirable for those who wish to stay in the hotel which has been named as headquarters for their society.

Some small hotels not on the board walk are quoting rates as low as $1.50 per person. Information regarding these will be furnished on request to the permanent secretary or to the Atlantic City Convention Bureau.

CHARLES F. ROOS,
Permanent Secretary

OBITUARY

THOMAS GEORGE LEE

PROFESSOR THOMAS G. LEE died on September 1, 1932, from injuries received in an automobile accident a few days previously. He had resided at Babson Park, Florida, since his retirement from the University of Minnesota as professor emeritus in 1929.

He was born at Jacksonville, New York, in 1860. He attended the University of Pennsylvania, where he received the degrees of B.S. and M.D. (1886). He was also awarded the degree of B.S. at Harvard University. During the last two years at Pennsylvania he served as student assistant in histology and embryology. Then he went to Yale University, where for five years he was lecturer in histology and embryology and director of the laboratory. He also taught these subjects for one year at Radcliffe College.

In 1892, he was called to the University of Minnesota as an instructor in the recently established school

of medicine. The pioneer conditions of that period are indicated by the fact that he not only established the laboratory of histology and embryology but also had charge of the work in bacteriology and clinical microscopy! According to the faculty minutes at that time 64 laboratory hours were allotted to histology, 10 lectures to embryology and 12 to bacteriology. With the development and expansion of the school, Dr. Lee was soon relieved of the extraneous subjects and concentrated his attention upon histology and embryology. His title as professor of these branches was changed in 1908 to professor and head of the department of anatomy. In 1913, he became professor of comparative anatomy.

Although quiet and modest in demeanor, Dr. Lee was firm and aggressive in his persistent efforts to increase the facilities and improve the standards of scientific laboratory work. For years he served as secretary of the medical faculty. As librarian, he also devoted much time to the foundation and development of the medical library. He visited the various laboratories of Europe and America in developing plans for the erection of a new Institute of Anatomy, which was completed at Minnesota in 1913.

His activities, however, were not restricted to teaching and administrative work. He was active in the investigation of mammalian embryology, and published several important papers on the early development, implantation and placentation of *Spermophilus tridecemlineatus* and related rodents. His collections of material in this field are extensive and valuable.

The breadth of his interests is indicated by his membership in many scientific organizations, including the American Association for the Advancement of Science, Sigma Xi, American Society of Naturalists, American Society of Zoologists (secretary-treasurer of the Central Branch, from 1906 to 1908), American Medical Association, Minnesota Academy of Medicine, American Association of Anatomists and Anatomische Gesellschaft.

In religion, he was a Unitarian. He was deeply interested in the Masonic order, and was a charter member of the University Lodge and of the Acacia fraternity. As a Knight Templar, he served as president of the council. In the Scottish Rite bodies, he was Master of the Lodge of Perfection and was honored with the 33rd degree of that organization. He was highly esteemed by his colleagues and is affectionately remembered by thousands of former students, who speak of him familiarly as "Tommy."

UNIVERSITY OF MINNESOTA C. M. JACKSON

WILLIAM AUGUST PUCKNER

DR. WILLIAM AUGUST PUCKNER, secretary of the Council on Pharmacy and Chemistry of the American Medical Association since March 1, 1906, died at the Presbyterian Hospital in Chicago, on October 1, 1932, aged 68.

Dr. Puckner was born in New Holstein, Wisconsin, educated at the Chicago College of Pharmacy, at Harvard University and the University of Heidelberg. He was professor of chemistry at the old Chicago College of Pharmacy, now the School of Pharmacy of the University of Illinois, from 1890 to 1910. He was a charter member of the Chicago section of the American Chemical Society and was chairman of the Chicago section in 1903. For many years Dr. Puckner was considered one of the leading alkaloidal chemists of the world. On March 1, 1906, Dr. Puckner was chosen secretary of the Council on Pharmacy and Chemistry and has continuously held that position for 26 years, during periods of which time it required courage to carry on in the face of great difficulties. In 1909, his vision became so impaired that it was necessary for him to give up laboratory work entirely and even to have the services of a guide. In spite of this handicap, Dr. Puckner carried on efficiently a most useful work in the interest of public good.

Dr. Puckner was a member of the committee on revision of the U. S. Pharmacopoeia and of the committee on synthetic drugs of the National Research Council. He received honorary degrees from the University of Pittsburgh and the Philadelphia College of Pharmacy.

P. N. L.

RECENT DEATHS

DR. WILLIAM LAMBERT RICHARDSON, professor emeritus of obstetrics and from 1899 to 1907 dean of the faculty of medicine of Harvard University, died on October 20, in his ninety-first year.

DR. MARCUS BENJAMIN, industrial chemist and editor of the publications of the U. S. National Museum, died on October 22, at the age of seventy-five years.

TINIUS OLSEN, a pioneer in the development of testing machinery in the United States, died on October 20, at the age of eighty-six years.

MEMORIALS

THE bicentenary of the birth of Nevil Maskelyne, astronomer royal at the Greenwich Observatory from 1765 until his death in 1811, occurred on October 6.

MEMBERS of the department of geological sciences at the University of California have presented to the university a portrait of the late Professor Arthur S. Eakle, done in charcoal by Peter Van Valkenburgh.

RESOLUTIONS expressing grateful appreciation of contributions made by the late Dr. George F. Kunz to the development of the American Museum of Natural History have been adopted by the scientific and ad-

ministrative staffs of the museum and forwarded to the board of trustees. It is suggested that a suitable tablet in memory of Dr. Kunz should be installed in the Morgan Memorial Hall.

A MEMORIAL to Sir Andrew Balfour at the London School of Hygiene and Tropical Medicine was unveiled on October 6 by the Earl of Athlone, chancellor of the University of London.

SCIENTIFIC EVENTS

THE MOUNT ST. KATHERINE OBSERVATORY OF THE SMITHSONIAN INSTITUTION

DR. CHARLES G. ABBOT, secretary of the Smithsonian Institution, announces the establishment of a solar observatory on the summit of Mt. St. Katherine in the Sinai desert.

The decision to establish the observatory on this desolate peak, rising 8,540 feet above sea level out of the desert, concludes, temporarily at least, a long search for the highest, driest accessible spot in the eastern hemisphere. In this search the possibilities of the high mountain tops of three continents have been surveyed.

Last year the institution abandoned its station on Mt. Brukkaros in south West Africa after making observations there for five years. At the time of its establishment it was the best that could be found in a country with stable political conditions, but it became steadily apparent that the errors due to unavoidable natural conditions—haze and terrific winds—were too great to make the observations fully satisfactory.

Alfred F. Moore, of the Smithsonian staff, finally turned to the Sinai desert when he was unable to find a suitable station on the African continent. He climbed Mt. St. Katherine and took observations for more than 100 days on the summit. These were judged sufficiently satisfactory to warrant the setting up of a permanent station, for which funds have been provided.

Mt. St. Katherine is about 12 miles south of Mt. Sinai, whose summit tradition accepts as the place of the revelation described in Exodus. The Biblical account, however, is vague and there has been considerable dispute among scholars. There has been a persistent tradition linking the Biblical story with the higher mountain. The nearest neighbors of the Smithsonian astronomers will be the monks of the great monastery of St. Katherine, 10 miles below on the mountain side.

For years the astrophysical observatory of the Smithsonian Institution, under the direction of Dr. Abbot, has been measuring daily the amount of solar radiation in different parts of the western hemisphere —at Washington, Table Mountain in California and Mt. Montezuma, Chile. The observations must be made with extreme accuracy under the most favorable conditions and it is essential to find a mountain in a desert where the water vapor is at a minimum and where there is a minimum of dust.

Mt. Montezuma in Chile is considered an almost ideal site. But the combination is hard to find in the Old World. In addition to the physical requirements for satisfactory observations endurable living conditions for the observer are necessary and it is essential that there be stable political conditions.

Mt. St. Katherine comes close to satisfying conditions. The monks of the neighborhood are friendly. There is very little moisture in the air. The winds are light and Mr. Moore's observations established that they generally blow from the Mediterranean Sea at the north, rather than from the dusty deserts to the eastward and westward.

THE NEW CRYOGENIC LABORATORY OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

THE new cryogenic or low temperature laboratory under construction at the California Institute of Technology is designed to produce comparatively large quantities of liquid hydrogen and helium at low cost. Science Service reports that the output is expected to be about five liters of liquid hydrogen an hour at a cost of $2.00 per liter. The plant in Berlin, which is the largest in the world, can produce twenty liters an hour.

There are so far only four European cryogenic laboratories and four in America, one at the Bureau of Standards in Washington, D. C., one in Berkeley, California, a third in Toronto, Canada, and a fourth at the Johns Hopkins University. Russia is planning a large plant in Charkow, France intends to install one in Paris, and Göttingen is about to build one also.

Professor A. Goetz, who is responsible for the Pasadena low temperature work, recently inspected European equipment. He observes that the first consideration in the design of a cryogenic plant is the danger of explosions due to the presence of liquid hydrogen. Accidents, sometimes involving fatalities, have occurred in different laboratories in the past, but they are avoidable. In fact, the oldest cryogenic laboratory, which is at Leiden, Holland, has been in daily operation since its opening by K. Onnes twenty years ago. Since his death a few years ago, its traditions have been carried on by De Haas. In all that time there has never been a single explosion.

The new laboratories all have elaborate safety systems. In Cambridge there are miners' lamps of the type invented by Sir Humphry Davy a hundred years ago. These are installed in corners of the ceiling where hydrogen is most likely to collect. Six per cent. or more of hydrogen in the air is a violently explosive mixture and can tear a closed building to bits. When one per cent. exists these lamps give a signal which automatically throws open all doors and windows.

In the German Physikalische Technische Reichsanstalt, which corresponds to U. S. Bureau of Standards at Washington, the cryogenic laboratory has a very light roof merely resting over the building. In case of an explosion this roof would be blown off before a high pressure could be built up.

At the Pasadena laboratory the room in which the hydrogen is liquefied has no sharp corners. All are carefully rounded and the ceiling slopes upward toward the window, which runs from floor to ceiling and is almost half as wide as the room. This window is to be kept open at all times of the year.

DEDICATION OF THE JENKINS LABORATORY AT THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

THE Jenkins Laboratory of the Connecticut Agricultural Experiment Station, New Haven, was dedicated on October 11, with tributes to the late Dr. E. H. Jenkins, director from 1900 to 1923, for whom the building was named. Dr. E. M. East, of Harvard University, who was at one time a member of the Connecticut station staff, praised Dr. Jenkins as "one of the great men of our generation."

"His most brilliant success was as director of this station," Dr. East said in his address, entitled "Edward H. Jenkins—The Man and the Public Servant." "In this capacity his work was so distinctive that he deserves, and is accorded, a collaborator's share in its entire output of scientific work. . . . Is it not just as well to have a little hero worship for that rare type of individual, the unselfish comrade who never lets you down?"

Dr. J. G. Lipman, director of the New Jersey Agricultural Experiment Station, spoke on "The Agricultural Station as a Public Service Institution." He commented on the question of agricultural research and over-production of crops that "If the truth must be told, the Experiment Station can furnish knowledge, but it can not furnish wisdom."

Governor Wilbur L. Cross, of Connecticut, formerly dean of the Yale University Graduate School, traced briefly the beginnings of the Connecticut station as a "Yale institution," and recalled his thirty-five years' acquaintance with Dr. Jenkins.

Concluding the program, Dr. E. M. Bailey, station chemist, presented a bronze tablet in memory of Dr. Jenkins, given by present and past members of the staff, and the building was thrown open for inspection. Elijah Rogers, of Southington, a fruit-grower and vice-president of the board of control of the station, presided. William L. Slate, director, extended greetings.

The new laboratory, which was built by appropriation of the General Assembly, houses the departments of entomology, plant breeding, botany and forestry, and provides individual laboratories for research workers. It is 124 by 45 feet in size, and is two stories in height, with a big light basement.

SCIENTIFIC NOTES AND NEWS

DR. W. W. CAMPBELL, emeritus director of the Lick Observatory and emeritus president of the University of California, is spending the winter in Washington in order that, as president of the National Academy of Sciences, he may be in touch with the administration of the academy and of the National Research Council.

ARTHUR KEITH, geologist of the U. S. Geological Survey from 1894 until his recent retirement, has been elected chairman of the finance committee of the American Association for the Advancement of Science to succeed the late Dr. George K. Burgess, director of the Bureau of Standards.

HENRI LOUIS LE CHATELIER, the French chemist, celebrated his eighty-second birthday on October 8.

DR. NIELS BOHR, professor of physics at the University of Copenhagen, expects to visit the United States in the summer of 1933.

THE honorary degree of doctor of science has been conferred by Dartmouth College on S. Prentiss Baldwin, who is founder and director of the Baldwin Bird Research Laboratory, and research associate in biology in the Graduate School of Western Reserve University.

DR. FRANCIS M. WALTERS, JR., of the staff of the bureau of metallurgical research at the Carnegie Institute of Technology, was presented with the Howe Medal for 1932 by the American Society of Steel Treating at a dinner held on October 6 in Buffalo as a part of the National Metals Congress. The medal was awarded for an article on "The Alloys of Iron, Manganese and Carbon," a study which was con-

ducted during the past year by Dr. Walters and his assistants, Dr. John F. Eckel and Maxwell Gensamer, who were awarded honorable mention.

J. S. TRITLE, vice-president and general manager of the Westinghouse Electric and Manufacturing Company, was elected president at the recent annual meeting of the National Electrical Manufacturers' Association, to succeed John H. Trumbull, formerly governor of Connecticut.

Nature reports that the British Institute of Transport has made the following premium awards for the session 1931–32: Institute Triennial Gold Medal to Sir Lynden Macassey; Railway (Operating) Gold Medal to H. H. Mauldin; Railway (Engineering) Gold Medal to Sir Harold Hartley; Road Transport (Passenger) Gold Medal to Horace M. Wyatt; Water Transport (Canal) Gold Medal to A. J. Pearson, and Institute Graduate Silver Medal to J. M. Powell.

DR. DAYTON STONER, of the Roosevelt Wild Life Experiment Station of the State College of Forestry, Syracuse, has been appointed state zoologist of the New York State Museum at Albany.

CURTIS P. CLAUSEN, of the Bureau of Entomology, formerly in charge of research work on parasites of the citrus black fly at Kuala Lumpur, Federated Malay States, has been transferred to Washington. In his new assignment, he will coordinate the work of the bureau and cooperating states on the study, breeding, importation and distribution of beneficial insects.

ON recommendation of the editor of the *Journal of the American Chemical Society,* R. C. Fuson and Farrington Daniels have been elected by the council of the society associate editors in place of Roger Adams and E. W. Washburn, whose terms expire. On recommendation of the editor of the *Journal of Physical Chemistry,* J. W. McBain and T. R. Briggs have been elected to the board of editors of that journal.

DR. DAVENPORT HOOKER, professor of anatomy at the University of Pittsburgh, has been appointed managing editor of *The Journal of Comparative Neurology,* to succeed Dr. Geo. E. Coghill, member of the Wistar Institute, who resigned in order to devote his full time to neurological research.

DR. PAUL D. FOOTE retired on September 1 as editor-in-chief of *The Journal of the Optical Society of America* and of *The Review of Scientific Instruments,* after having served for more than twelve years. The *Journal* says: "During the thirteen years of Dr. Foote's editorship he has personally supervised the publication of over 15,000 pages of text—a task which, as those who have had experience know, has demanded very heavily of his time and energy. To have been thus instrumental in starting and in conducting for a long period of years two important scientific journals, is an achievement of which any one may be proud. On behalf of his colleagues on the editorial board, and of the many readers of *The Journal of the Optical Society of America* and of *The Review of Scientific Instruments,* we wish to take this occasion to express to him our sincere appreciation of his untiring energy and of his devotion to the editorial work which he has so ably done. We regret that his duties as director of the Research Laboratory of the Gulf Oil Companies make it impossible for him to continue with us. But we shall hope that the standards which he set shall be maintained, and that the journals shall continue to prosper."

DR. J. B. S. HALDANE, Sir William Dunn reader in biochemistry at the University of Cambridge, head of the genetical department of John Innes Horticultural Institution and Fullerian professor of physiology at the Royal Institution, London, has been appointed Hitchcock professor at the University of California. The first series of lectures opened on October 18 with an address entitled "Criticism of the Darwinian Theory." A second series will include three lectures on "Enzymes." Professor Haldane will also give two lectures on "Biochemistry and Genetics," and one lecture on "Mathematical Problems Arising in Genetics." These lectures will be: Nov. 9, "How Genes Act"; Nov. 10, "What Genes Are. Wave Mechanics as a Basis for Philosophical Biology," and Nov. 14, "The Statistical and Matrix Algebra of Population. Problems Leading to Linear Difference Equations." In addition to lectures Professor Haldane will hold a number of conferences and discussions with members of the faculty and advanced students.

E. A. GUGGENHEIM is visiting the department of chemistry at Stanford University as acting assistant professor for the year 1932–1933, giving courses on Gibbsian thermodynamics and on catalysis in solutions. Mr. Guggenheim was for five years in Copenhagen as research assistant, first with Professor Brönsted at the Polytechnic Institute and later with Professor Bjerrum at the Royal Agricultural College.

FREDERICK BATES, chief of the polarimetric section of the Bureau of Standards, has recently returned from a tour of European laboratories. He was elected president of the International Commission for Uniform Methods of Sugar Analysis which met at Amsterdam in September.

VERNON BAILEY, of the Bureau of Biological Survey, left Washington on October 18 for a three-months biological expedition in northwestern Mexico, with Frederic Winthrop, Jr., collector for the Museum of Comparative Zoology at Cambridge, Massachusetts. They will travel by pack horse through the canyons

and mountains of northwestern Chihuahua and northeastern Sonora and by automobile through the deserts of northwestern Sonora and along the coast of the Gulf of California.

DR. BENNET M. ALLEN, professor of zoology of the University of California at Los Angeles, has returned after spending nine months in Europe, engaged chiefly at the larger universities and medical centers in a study of the pituitary and thyroid glands.

W. J. BAERG, professor of entomology at the University of Arkansas, has returned from a six weeks' trip into Mexico. The trip was made for the purpose of studying poisonous arthropods in the States of Morelos, Guerrero and Oaxaca.

DR. ERIC REID, of the Rowett Institute, Aberdeen, Scotland, who spent the past academic year in the department of biochemistry, Western Reserve University, as a scholar of the Department of Agriculture for Scotland, has returned to Aberdeen.

DR. PETER DEBYE, professor of experimental physics at the University of Leipzig, who is visiting the United States, expects to spend a week in conferences at the California Institute of Technology at Pasadena.

THE meetings of the British Illuminating Engineering Society opened on October 11, when Lieutenant Commander H. T. Harrison delivered his presidential address and a report on progress in illuminating engineering, prepared by the Technical Committee, was presented.

PROFESSOR WILLIAM HENRY WELCH, of the Johns Hopkins University, lectures at the New York Post-Graduate Medical School of Columbia University on Friday, October 28, at 5 P. M. His subject is "The Significance of Medical History to the Practitioner of Medicine."

DR. WALTER B. CANNON, professor of physiology at Harvard University, will give the eighty-sixth anniversary discourse at the New York Academy of Medicine on November 3 at 8:45 P. M. His subject will be "Enemies of Society."

DR. ROBERT A. MILLIKAN, of the California Institute of Technology, addressed the student body of Lafayette College on October 26, his subject being "A New Set of Values."

THE thirty-first Hanna lecture of Western Reserve University was delivered on October 10 by Dr. W. Baensch, professor of radiology and director of the X-ray and Radium Institute of the University of Leipzig. The lecture, which was illustrated, was on "The Radiological Relief of the Gastric Mucosa."

DR. PHILIP ANDERSON SHAFFER, professor of biological chemistry and head of the department, Washington University School of Medicine, St. Louis, will deliver the third series of Herzstein lectures on the general subject "Some Aspects of Carbohydrate Metabolism and Their Bearing on Clinical Problems." Under the provisions of the will of the late Dr. Morris Herzstein, San Francisco, the Herzstein lectures are held in San Francisco under the auspices of Stanford University and the University of California.

THE fourteenth Exposition of Chemical Industries is now definitely scheduled for the week of December 4, 1933, according to a recent announcement by Charles F. Roth, manager, who is vice-president of the International Exposition Company, which has organized and directed the presentation of the Chemical Exposition since the first one was held in New York City in 1915. The exposition will be held simultaneously with the annual meetings of the American Society of Mechanical Engineers and of the American Society of Refrigerating Engineers. It is probable also that certain of the national chemical organizations may arrange to hold meetings in New York during the week.

THE residue of the estate of Dr. M. Allen Starr, professor and emeritus professor of diseases of the mind and nervous system at Columbia University from 1888 until his recent death, will be held in trust and ultimately will be shared equally by Princeton and Columbia universities.

The London Times reports that Captain Eynar Mikkelsen's expedition to the Blosseville Coast, East Greenland, returned to Copenhagen on September 22. Three British scientific men, Mr. Michael Spender and the brothers, Mr. R. G. Wager, of the University of Reading, and Mr. H. G. Wager, of the University of Dublin, have been taking part in it. In addition to other scientific work the difficult Blosseville Coast was mapped in detail. Captain Mikkelsen says that he visited Lake Fjord a few days after the loss of Mr. Watkins in a kayak accident, and helped in the search for him. Four members of Dr. Knud Rasmussen's seventh Thule expedition have also returned after having, from a seaplane, mapped the coast from Angmagssalik to Cape Farewell. In all they flew 10,000 miles without mishap. East Greenland has now been explored by Danes from Cape Bismarck in the north to Cape Farewell in the south.

A PROPOSED dictionary of electrical engineering terms, representing the results of over three years' work by a committee of 120 scientific men and engineers under the chairmanship of Dr. A. E. Kennelly, of Harvard University, has been published for review and criticism prior to its submittal to the American Standards Association for adoption as an American standard. The report, prepared under the direction of the American Institute of Electrical Engineers, is

a document of 208 pages listing over 3,400 definitions, ranging from the fundamental definitions on which the science of electricity is based, to definitions for practical applications, such as those for control equipment, generation, transmission and distribution, welding, illumination, wire and radio communication, electrobiology and electro-therapeutics.

THE University of Kentucky, in cooperation with the State Board of Health, during the 1932 summer session offered a group of special courses for the public health workers of the state. Dr. Allen W. Freeman, professor of public health administration, the Johns Hopkins University School of Hygiene and Public Health; Dr. Edward J. Murray, superintendent of the Julius Marks Sanitarium, Lexington; Miss Margaret East, director of the Bureau of Public Health Nursing, State Board of Health, and Dr. J. S. Chambers, department of hygiene and public health, University of Kentucky, formed the resident staff, while various members of the staffs of the University of Kentucky and the State Board of Health gave special lectures. The courses offered were epidemiology, public health administration, health supervision of schools, tuberculosis, public health nursing and maternal and child health. Twenty-five health officers were enrolled for the courses offered for health officers only, while thirty nurses and eighteen teachers were enrolled for the courses offered these workers.

AT the recent Denver meeting of the American Chemical Society the following resolution was adopted:

RESOLVED, That the Secretary of the American Chemical Society be instructed to advise the Century of Progress of the facts relative to the meeting of the American Chemical Society in Chicago in September, 1933, and urge in effect that the Century of Progress advise the distinguished foreign chemists whom they have invited, of these facts, and try to arrange for at least some of these chemists to remain until September, when the meeting of the American Chemical Society would provide a large audience of their American colleagues. In this, the secretary will invite the cooperation of the American Association for the Advancement of Science.

It was voted to instruct the secretary at the proper time to advise the chemists of the world of the meeting to be held by the American Chemical Society in Chicago at the time of the Century of Progress, extending to them the privilege of attending this meeting on the same basis as members of the American Chemical Society, as was done at the society's jubilee in 1926. The society will meet in St. Petersburg, Florida, in March, 1934, and in Cleveland in September. With reference to the question of future meetings the following motion was passed:

Voted that the council policy committee present to the council at its next meeting a plan whereby the selection of the meeting places for the society be made in a more logical manner; that their report include a tentative schedule some years in advance, together with any proposed amendments to the constitution and by-laws they may deem necessary to carry it into effect.

DISCUSSION

VITALISM, MECHANISM AND ORGANICISM

To such of the brethren as have wondered at times just where the organicism of Claude Bernard stands in the logical scheme, it may be of service to attempt a dichotomy to show its real position.

We may start our scheme of dichotomy with the vitalistic position, namely, that the reactions in living organisms are not completely explicable in terms of physics and chemistry; that there is some supernatural or ultranatural element in these processes which puts them beyond the range of jurisdiction of so-called natural laws. Descartes (1596–1650), while admitting that some of the processes of the organism were physical or chemical in nature, was the first to insist upon a sharp dualistic separation between any such physical and chemical processes and the rational soul. Present-day vitalism dates from Stahl's (1660–1743) *anima sensitiva* rather than from Descartes' *âme raisonable.* In contrast to this we may put the other division of biological thinkers who maintain that there is no supernatural element in the processes in living organisms. This position has been stated most graphically by Goodrich; "The metabolic process in living matter draws in inorganic substance and force at one end, and parts with it at the other; it is inconceivable that these should, as it were, pass outside the boundaries of the physico-chemical world, out of range of the so-called physico-chemical laws, at one point to reenter them at another."

The second group of thinkers have sometimes been called mechanists, and to some it might appear that the dichotomy, as it has been presented, includes all possibilities. But the organicists hold a different opinion. They say that neither mechanism nor vitalism contains the answer to the biological riddle. There may be others beside myself who have been sorely puzzled to find their place in the scheme.

Suppose that we let vitalism stand as it is, for if the organicists deny that they are vitalists, no one has a right to put them there against their will. Certainly, Claude Bernard was not a vitalist. And a third category of organicism, coordinate with the other two, does not seem easy to establish. It seems worth while, then, to look a little more closely at our second category, which is commonly designated by the term "mechanism." Most biologists will recall

having come across, somewhere or another, the statement that a particular biological process is not a physical-chemical process. Such a statement, while frequent enough, in one guise or another in the literature, leaves certain things to be desired. One of these unfulfilled—but not suppressed—desires is the failure to designate just what shall be done with this reaction which is not a physico-chemical reaction, particularly when the author has somewhere or another stated that his position is not that of vitalism. Suppose that we say, as the second division of our dichotomy, that the processes in living organisms are natural processes, nowhere crossing the border into the supernatural, but frequently lying over the border of the unknown. It seems possible to state two possible alternatives of this second category. The first possibility would appear to be that the reactions in living organisms, being physico-chemical in nature, are the same in quality and direction that they would be in an inorganic system if such a system could be placed under the same conditions. We might designate this as the strictly mechanistic position. Our second alternative might be stated as follows: the reactions in living organisms are physico-chemical in nature and not supernatural; but they do not always occur in the same direction as they would in an inorganic system under the same conditions, or are not qualitatively the same. This appears to be the clearest statement which I can make of the organicist position, and I believe that it is logically sound. The main point of debate, then, between mechanist and organicist would not be whether the processes in living organisms spill over into the realm of the mysterious at times, but whether they are, or are not, exactly the same in nature and direction in living organisms as they would be in inorganic systems under the same conditions. And if we can now and then show that a reaction in a living organism is not the same in direction as it would be in an inorganic system, under the same conditions, I, personally, see no need whatever for invoking vitalism.

When we reflect that, since the appearance of living organisms upon the earth, every stratum of the earth's crust which has been exposed to the same environmental conditions as the living organism has been changed, sometimes almost beyond recognition, while living organisms have persisted, we seem driven to the conclusion that the processes in living organisms have not always been the same in direction as in the inorganic systems of the rocks. There seems to be a facility of adaptation in living organisms which is not present, to the same extent at least, in inorganic systems. Treviranus regarded this facility of adaptation as one of the most characteristic properties of living organisms. I[1] have presented elsewhere the argument that at least some phases of adaptation can be considered as a special case under the theorem of Le Chatelier. Such a view seems consistent with the position of the organicist, and needs no entelechy.

F. H. PIKE

COLUMBIA UNIVERSITY

A NEW DISEASE OF MOOSE. III

A NEW BACTERIUM

IN a recent paper, the first of this series, Thomas and Cahn[1] have described a new disease among the moose (*Alces americana americana*) in northeastern Minnesota and the adjacent region of Ontario, Canada. The disease is described as appearing in the early spring, coincident with the final metamorphosis of the tick *Dermacentor albipictus* into the adult stage, which tick heavily infests the moose of this area. The symptoms are described as marked activity shown by blind, aimless wandering, followed by a paralysis of the limbs and death in a great many cases. Ticks taken from animals dying of the disease transmitted the disease to guinea pigs and rabbits in the laboratory, these dying with symptoms similar to those exhibited by the moose. The blood picture accompanying the disease is described and the presence of bacteria noted. An organism was isolated which, when inoculated into experimental animals, produced the symptoms of the moose disease and caused death. In a second paper, Wallace, Thomas and Cahn[2] discuss further experiments with this isolated organism and emphasize its extreme virulence. Guinea pigs and rabbits were killed in an hour by inoculating the organism or a filtrate of the organism. This virulent organism was pronounced a bacterium, and was placed tentatively in the Klebsiella group. It is a capsulated rod form with a tendency to assume a coccoid shape; it grows as an excessively mucoid colony on agar, and produces Beta hemolysis on blood agar. Its growth is extremely rapid, covering an agar slant in five hours, and it apparently produces an extra-cellular toxic substance. Since this paper was published a great deal of work has been done upon the organism, involving its life history, pleomorphic behavior and physiological reactions. With much of this completed, the writers are convinced that it is a new organism not hitherto described, and because of the seriousness of the disease which it

[1] F. H. Pike, *Ecology*, iv, 129, 1923.

[1] Thomas, L. J., and Cahn, A. R. A New Disease of Moose. I. Preliminary Report. *Journ. Parasit.*, XVIII: 219–231, 1932.

[2] Wallace, G. I., Thomas, L. J., and Cahn, A. R. A New Disease of Moose. II. *Proc.* Soc. Exp. Biol. and Med., XXIX: 1098–1100, 1932.

causes, together with its astonishing virulence, they believe it should be named. This organism is therefore designated as *Klebsiella paralytica,* because of the paralysis it causes. A detailed report, covering all experimental and cultural work to date, is about to go to press.

A. R. CAHN,
G. I. WALLACE,
L. J. THOMAS

UNIVERSITY OF ILLINOIS, URBANA

CRYSTALLINE d-MANNURONIC ACID

CRYSTALLINE d-mannuronic acid has recently been isolated in my laboratory by Mr. Eugene Schoeffel. Heretofore, d-mannuronic was known only in the form of its lactone. The lactone m. p. 140–141° $(\alpha)\frac{25}{D}+89.8°$ was isolated for the first time by Nelson and Cretcher,[1] and subsequently by Schoeffel and Link.[2] The free acid was obtained by decomposing barium d-mannuronate, prepared from the algin of *Macrocystis pyrifera* and *Fucus serratus* after the procedure of Schoeffel and Link,[2] at −10° in the presence of ethyl alcohol. The acid melts at 165°, has an initial specific rotation of −50° and a final value of −20° (after 2 hours) in water. Dr. C. S. Hudson, of the National Institute of Health, Washington, D. C., has calculated that the specific rotation of the beta form should be −37° (private communication). It appears, therefore, that the form of d-mannuronic acid which we have in hand is the beta variety. Experiments are under way by my collaborator, Mr. Carl Niemann, to synthesize d-mannuronic acid by the reduction of d-mannosaccharic acid. The details of this work will be published elsewhere.

KARL PAUL LINK

DEPARTMENT OF AGRICULTURAL CHEMISTRY
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TWO BUSTS OF GREAT SCIENTIFIC MEN

DURING the past summer I happened upon two life-size marble busts that I am sure would be of interest to all physiologists and medical men—one of Johannes Müller, the biologist, and teacher of R. du Bois-Raymond, Helmholtz and Virchow, the other of the great Graefe, father of scientific ophthalmology. The sculptors, Drake and Siemering, respectively, are of hardly less renown. Their artistic and historical creations to-day adorn salons, public buildings or parks not only in Europe but also in America.

These two busts are now in the possession of Frau Professor Engelmann, of No. 52 Knesebeck Strasse, Berlin, W15, Germany, who must sell them at once on account of straitened circumstances. These busts would be a lasting adornment of historical value to any library of medicine, or to any medical school. Persons interested in the purchase of one or both statues should correspond with Frau Engelmann directly or with the undersigned.

CHARLES D. SNYDER

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SCIENTIFIC BOOKS

Chemical Embryology. By JOSEPH NEEDHAM, M.A., Ph.D., fellow of Gonville and Caius College, Cambridge, and university demonstrator in biochemistry. Three volumes, 2021 pp., 1931. Cambridge: at the University Press; New York: The Macmillan Company. Price, $35.00.

THIS book, which, as its title indicates, marks a turning-point in the mode of approach to the traditional biological problems, is one of the most remarkable among recent works of biological scholarship—remarkable alike in its comprehensiveness, its critical and philosophical spirit, its excellence of style and arrangement, its clearness and lack of bias in discussion, its prevailing good sense and fairness in the appraisal of fact and theory. The treatment is extended and detailed, even leisurely. The author aims at giving an exhaustive account of our existing knowledge with regard to the chemical and physico-chemical aspects of embryonic development. He is well aware of the provisional nature of his undertaking, which is largely to clear the ground for the future; his main purpose is the furtherance of the study of embryology as an exact science, and he is conscious of the limitations of our present knowledge and of the need of advance in new directions and by new methods. The variety and range of material reviewed—not merely summarized but discussed with a keen sense of its general significance—are impressive. The bibliography alone occupies 242 pages, the reference to each treatise or paper being accompanied by a statement of the page where it is cited in the book. A feature of the treatment is the large number of original tables, graphs and diagrams. Wherever possible the material is presented quantitatively; in his final paragraph the author emphasizes the advantage,

[1] W. L. Nelson and L. H. Cretcher, SCIENCE, 67: 527, (1928); *Jour. American Chemical Society,* 51: 1914, (1929); 52: 2130 (1930).

[2] E. Schoeffel and K. P. Link, *Jour. Biol. Chem.,* 95: 213 (1932).

both in conciseness and exactitude, of substituting graphs and nomograms for verbal description. The historical side receives much attention and is illustrated by many citations and by reproductions of older pictures and portraits.

Such a work starts from the recognition that parallel with the morphological development runs a chemical development; to the specific morphogenetic sequence of ontogeny corresponds an equally specific chemical and physical sequence; the main task of the chemical embryologist is to trace the connection between the two. The microscopical methods show the morphological transformation of the germ; this process is observed to depend on local inequalities of growth associated with progressive differentiation; but it is evident that underlying each local morphogenetic process is a local biochemical process; this has both a synthetic and a catabolic side and is intimately associated with physical processes having to do with the deposition, removal and redistribution of reaction products. The physico-chemical factors of diffusion, surface action, osmotic pressure, bioelectric processes, temperature, catalysis, ion-action all contribute to the total result. Since the developmental sequence, considered as a whole, has orderly and constant character and leads to a definite and complexly organized end-product, the problem of the nature of the integrative factors coordinating the various component processes (often widely separated both in space and time) also comes up for consideration; this problem proves to be the most fundamental and difficult of all.

It must be confessed that our knowledge of the physiological factors controlling the course of development as a whole is at present far from adequate. Genetics shows a constant relation between the behavior of nuclear units (genes), in maturation and fertilization, and the appearance of definite characters in later development; but it has little to say regarding the special physiological conditions which determine and coordinate the separate chemical and physical events of the complex intervening sequence. The genes represent a factor of stability; so much seems clear; but stability, although a necessary factor in any transformation, does not account for its detailed course. It is true that certain definite factors of physiological control can be demonstrated experimentally; *e.g.*, the dominance or Organisator influence, the hormone influence (*e.g.*, in sex-determination); there are also the special provisions for embryonic nutrition (yolk, placenta), and many special structural devices like the amnion (the "private pond" of the embryo) and allantois of vertebrates. The author describes in detail the biochemistry of the egg-yolk, of the embryonic blood and tissues, of the amniotic and allantoic fluids, of the placenta; the factors of placental interchange are also discussed. One feels that much of this information has no special relevance to the problem of development as such; many biochemical stages, like many structural stages, appear to be important chiefly as scaffolding or temporary factors of stability. The relation of a descriptive biochemistry of the embryo to the factors of development is not always clear. This impression becomes stronger on reading the excellent chapter on the "Energetics of Development"; eggs and embryos of equal energy-content, but of different species, develop differently; evidently the factor of energy as such, while integral to the developmental transformation, has nothing to do with determining its special course. As Driesch has recently remarked,[1] the physical concept of energy is purely quantitative and non-directive; what we require to know is the special direction and time of its application, especially in the submicroscopic processes controlling the inner detail of the transformation.

In the concluding section ("Epilegomena") the author gives a list of provisional generalizations for chemical embryology; these are largely factual summaries independent of theoretical interpretation. A brief discussion on organization follows. In the formative action of the germ Needham sees evidence of an organization extending beyond the molecular level. "Living matter shows a constellation of processes strung together in a more highly organized manner than anything in the non-living world." The ultimate factors of development are to be regarded as immanent in the organized matter itself, and not as superposed from outside. All vitalistic hypotheses of a non-material entelechy are to be set aside as irrelevant to science. The unique fact about the living germ is its advance in complexity as it develops, in contrast to the tendency toward increase in randomness or non-organization so characteristic of the non-living world. The author touches on a fundamental problem here, but does not discuss it at length. He expresses himself as hoping much from the applications of the new physics to biology.

These are problems for the future. To the reviewer it seems unlikely that the directive feature so conspicuous in embryonic development can be understood physically without reference to ultimate small-scale factors of an intra-atomic nature; apparently these factors would have to be conceived as acting asymmetrically in space and in orderly sequence in time in correspondence with some kind of internal control. The chief scientific difficulty here is that such internal factors are, in the nature of the case, largely removed

[1] In a review of the work of E. Rignano, *Scientia*, January, 1932, p. 69.

from the possibility of observation, for the reason that observation itself requires transfer of physical influence (quanta) from one atomic system to another and eventually to the sense organs of the observer. The inner conditions determining the precise time and direction of any such transfer are themselves outside the range of possible observation. If we regard the physical as that which is externally or publicly observable (directly or indirectly), there would seem to be implied in such a view a transition to unknown factors of the metaphysical world. Since science aims, above all, at clearness and intelligibility, such a reference might seem inadmissible to many biologists. But we must not overestimate the finality of our present methods. Philosophical considerations have their place in science, although, as Needham everywhere insists, in the work of investigation itself reliance can be placed only on methods of precise and (where possible) quantitative observation and formulation.[2]

The presswork and bookmaking of these three volumes are admirable, and they are remarkably free from misprints. We have noticed a misplaced decimal on p. 793, where the isotonic concentration of a salt solution is given as 8.5 per cent. instead of .85 per cent.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DEVICE FOR MEASURING THE MASS OF SMALL AQUATIC ANIMALS

IN the course of experiments concerning the density and growth of populations of certain small fishes (*Lebistes reticulatus* Peters),[1] it became desirable to obtain an accurate measure of the total mass of living material without injury to the specimens. The common method of estimating such a quantity, by means of noting the simple increase on introduction into a graduated measure partly filled with water, proved to be insufficiently accurate. This was chiefly because of the irregular introduction of drops of fluid which occurred if very small fishes were handled with sufficient rapidity to avoid injury.

In order to circumvent these difficulties, the device illustrated in Fig 1 was constructed. A reservoir "R" contains water identical in temperature and chemical condition with that from which the specimens to be measured were taken. A membrane filter "F," minus the membrane but retaining the perforated porcelain strainer, forms a receptacle for the fishes. These two elements are connected by a three-way cock "C" to a two-way burette "B." The measuring chamber of "F" is marked by two horizontal lines H_1 and H_2 which may be located at any convenient place. The volume contained in the chamber between H_1 and H_2 must be somewhat less than the capacity of the burette. The operation is as follows:

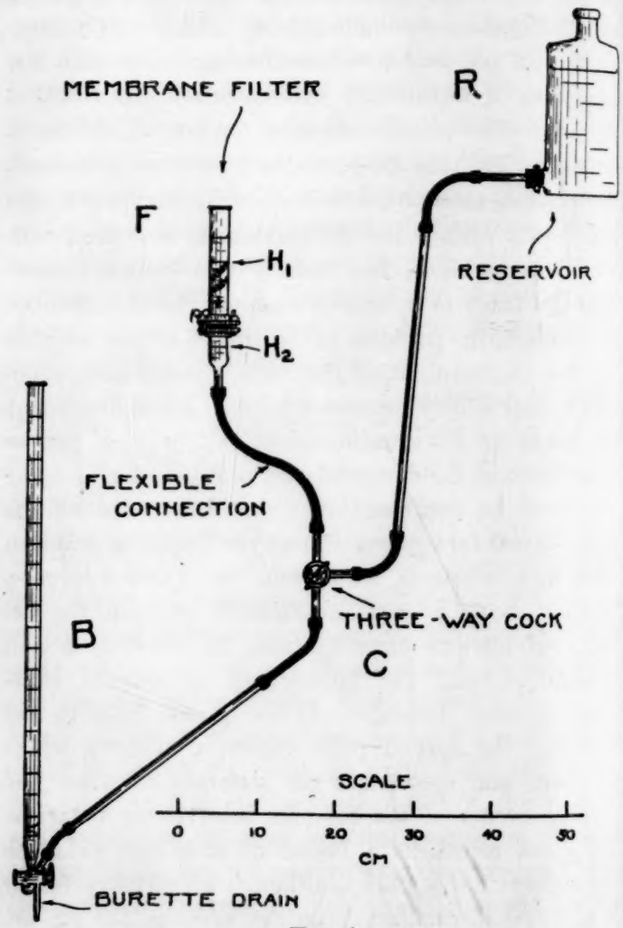

FIG. 1

Chamber "F" is nearly filled with water from "R" by means of cock "C." The fishes to be measured are introduced into "F." The water level in "F" is then lowered to H_1 by means of cock "C," the cock on the burette being in such a position as to be open to its connection with "C." There should be enough water admitted to the burette in this manner to allow it to rise to at least the first graduation. When H_1 has been reached, the burette cock is closed and a reading taken. Cock "C" is left open. The burette cock is now opened again, allowing the water to rise in the

[1] The specific problem on which this apparatus found its chief use was discussed under the title "A Preliminary Study of Population Stability and Sex Ratio in *Lebistes*," at the May, 1932, meeting of the American Society of Ichthyologists and Herpetologists, in Washington, D. C. This paper is to appear in an early number of *Copeia*.

[2] This is also Driesch's contention (*loc. cit.*, p. 70): "The sciences of nature with their rigorous method are the treasure of true knowledge."

burette and fall in the chamber "F." When H_2 is reached, cock "C" is quickly turned to connect "R" with "F." This cuts off the burette and returns the fishes to their native element quickly and with a single operation. The second burette reading may now be taken at leisure. By operating in this manner, the living material is removed from the water only an extremely short time, and in the species used no injurious effects have thus far been detected.

After the reading has been made and the fishes removed from chamber "F," by pouring out, the flexible connection between "F" and "C" allowing of this, the burette is drained through its other outlet by means of the lower cock and the device is again ready for operation. All parts except the reservoir "R" are mounted on a narrow vertical board, more compactly than shown in the diagram.

The second reading is subtracted from the first, the result representing the number of cc of fluid in the chamber "F" between H_1 and H_2 minus the mass of the fishes. Subtracting this figure from a "blank" run under similar conditions (representing the capacity of "F" between the two levels) the mass of fish in cc is obtained.

It is evident that this device could be applied to a wide variety of aquatic laboratory animals, and for many statistical purposes concerning such problems as growth, respiration, population concentration, *et cetera*. The degree of accuracy attainable is largely a matter of design. For very fine work, the burette "B" may be replaced by a chamber slightly smaller than chamber "F," on which may be mounted a microburette. The smaller the diameter of chamber "F" at H_1 and H_2, the greater accuracy attainable. This diameter, which must be based on the material to be used, is clearly the limiting factor for the accuracy of the readings.

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EXPANDING THE TYPEWRITER

PROBABLY every one engaged in scientific work has felt the need of typewriter characters other than those found on the standard keyboard. Special typewriters have been built, but are not satisfactory on account of the human element involved; typists have learned the touch method of operating the standard keyboard and as a rule refuse to use a special machine. In my own work the need has been met by a simple attachment that permits the use of any number of special characters.

A pillar AB in the diagrams is slipped onto the guides C, between which any type bar D must pass before striking the ribbon R. It is held in place by

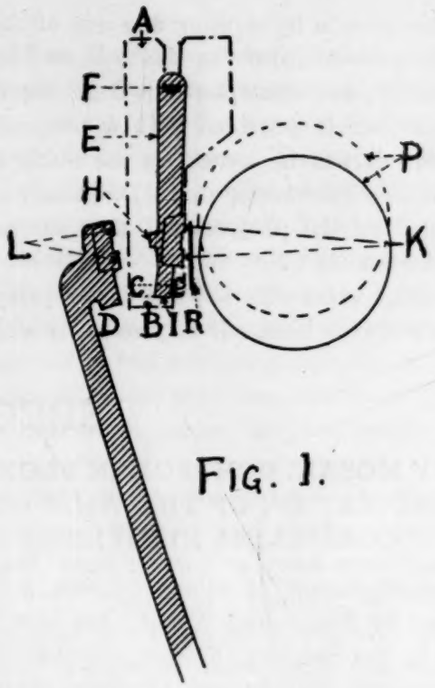

FIG. 1.

friction and can of course be removed easily when the machine is to be used for ordinary correspondence. Even when in place on the guides, it does not entirely spoil the "visibility" of the typewriter. The special characters are soldered to bars such as E designed to be supported by the pillar. Each bar has near one end a rather long axle FG, about which rotation can take place; the projecting ends of the axle provide a convenient means of handling the bar. Each bar carries two characters K; one will print when the typewriter mechanism is in its normal position and

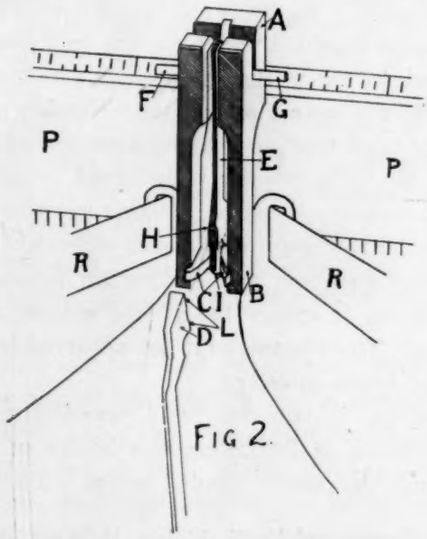

FIG 2.

the other when the "shift" key has been depressed. The bar must be set in motion by a blow so that one of its characters may strike the ribbon R and print in the usual manner. The most convenient method of

giving this blow is by striking any one of the regular keys. To prevent injury to the type on the typebar thus actuated, for example, bar D in the diagrams, the special bar is provided with a projection H so placed that it will be struck by the blank space between the two characters, L, on D. Exact alignment is provided by the projection I that moves between the regular guides C.

A block of wood with holes in it, properly labeled, serves to store the bars. It may seem offhand that the selection of the proper bar, its insertion in the pillar, the depression of the "shift" key if necessary, the striking of the blow, and the replacement of the bar in the block of wood, consume too much time. Actual experience shows that the entire process requires less time than does the insertion of special characters by hand. The device will make several carbon copies and will, of course, also cut neat stencils.

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SPECIAL ARTICLES

CELERY MOSAIC CONTROL IN FLORIDA BY ERADICATION OF THE WILD HOST COMMELINA NUDIFLORA

A MOSAIC disease of celery (*Apium graveolens*), mentioned by Foster and Weber,[1] has been troubling growers in the Sanford, Florida, district. Doolittle[2] stated that the malady was of virus nature, transmitted by *Aphis gossypii*, and affected a weed, *Commelina nudiflora*. The disease, according to a preliminary report by Wellman,[3] can be controlled by eradication of weeds, mainly Commelina, from about celery fields. As further stated by Doolittle (*loc. cit.*), celery and Commelina are affected by cucurbit mosaic, but subsequent studies by the present writer have shown that the mosaics of celery and cucurbits, though similar, are probably distinct.

Several insects were studied as carriers of celery mosaic. Grasshoppers, crickets, cutworms and other moth larvae, flea beetles, lantern flies, leaf-hoppers and two other species of aphids were used in addition to *Aphis gossypii*. *A. gossypii* (known as the "celery aphid" in the Sanford region) is the only insect which was found to carry the disease. Both winged and wingless adults were about equally capable of its dissemination, and nymphal stages were less effective.

Celery mosaic is readily transferred from celery to celery by mechanical means. Plants growing close together in the row may bruise each other when pushed over during spraying and cultivation practices, such injury serving to spread the disease without aphid intervention. The disease, as it has occurred in Florida, is not seed-borne in celery.

Commelina, known as "wild wandering-jew" by celery farmers, is found on the banks of drainage canals and in partly shaded areas. The weed is perennial, is propagated by seeds as well as bits of stem and is commonly affected by celery mosaic virus in nature. The disease is not carried in Commelina seeds, but lives from season to season in the growing plants. Careful search disclosed that the celery aphid occurred in small numbers on healthy and diseased Commelina plants. First occurrence of celery mosaic in the field was usually on the edge next to beds of mosaic-affected Commelina. At the outset spread was slow, but as the season progressed it was more rapid. It soon escaped from areas at the edges of the fields, and appeared in numerous isolated spots at some distance from points of origin. This suggestion of aphid flight was verified by subsequent observations. Later, these areas enlarged in all directions, irrespective of prevailing winds or orientation of rows of plants. In the beginning, winged forms of *Aphis gossypii* were the most important factors of distribution. From then on both winged and wingless forms served to spread the malady.

Spraying and dusting experiments to eliminate aphids were conducted by C. B. Wiseeup, U. S. Department of Agriculture, Bureau of Entomology, but did not give commercially satisfactory disease control. Successful control of celery mosaic by weed eradication around celery fields has been reported.[4] This work was started in the fall of 1930 and continued until the summer of 1932.

During the winter seasons of 1930–1931 and 1931–1932, four fields were selected and systematic study made from the time of transplanting to harvest. The experimental fields were on farms in the heart of the badly diseased area in the Sanford celery-growing district. In the winter of 1927–1928, on parts of these farms around 70 per cent. of the crop was lost, due to mosaic. In the 1928–1929 season, the losses averaged around 75 to 80 per cent. and in the next season were about 60 per cent. Because of low temperature during the first season of weed eradication, 1930–1931, loss from celery mosaic at harvest on the farm on which no weeds were removed amounted to about 26

[1] A. C. Foster and G. F. Weber, "Celery Diseases in Florida," *Florida Agr. Exp. Sta. Bull.*, 173: 23–77, illus., 1924.

[2] S. P. Doolittle, "*Commelina nudiflora*, a Monocotyledonous Host of Celery Mosaic," *Phytopath.*, 21: 114–115, (abstr.), 1931.

[3] F. L. Wellman, "Control of Celery Mosaic by Eradicating Wild Hosts," *Phytopath.*, 22: 30, (abstr.), 1932.

[4] F. L. Wellman, *loc. cit.*

per cent. Across the road from this farm, where a 60 per cent. loss had been sustained in 1929–1930, weed eradication was practiced, and only 6 per cent. of the celery was thrown away on account of mosaic. In another field where eradication measures had been practiced, only 4 per cent. of the crop was lost. Weed eradication was not started around these two fields until ten days after the crop was transplanted. In another field weed eradication measures were put into effect two months after transplanting; and at harvest time the loss from mosaic, 25 per cent., was practically as severe as where no weeds had been removed.

Detailed laboratory and greenhouse studies, made during and following the winter of 1930–1931, showed that Commelina was probably the only important wild host and that the celery aphid was probably the only important insect carrier of the trouble. In 1931–1932 weed eradication was started before celery was transplanted and continued during the winter. Commelina was the only weed removed from about experimental plots. This winter was unusually warm and mosaic spread much more rapidly and widely than during the previous season.

Commelina was not removed from around one field during the winter of 1931–1932. At harvest a small number of plants still remained healthy, but the grower considered it too small to be worth harvesting. In two near-by fields around which Commelina had been removed, one showed that less than one per cent. of the crop was lost due to mosaic, and in the other the loss amounted to a little more than one and a half per cent.

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THE EFFECT OF THE ELECTROPURE PROCESS OF TREATING MILK UPON BACTERIAL ENDOSPORES[1]

IN a recent paper[2] the Electropure process was described, and it was concluded that the process operating at 71° C. on an experimental basis was very effective in destroying resistant bacterial endospores. The results of these experiments indicated that another factor, in addition to heat developed in the milk, might be partially responsible for the endospore destruction. There seemed to be a strong indication that, in the case of endospores, the destruction might be partially caused within the cells. It is a known fact that the more concentrated an electrolytic solution becomes, the less resistance it offers to an alternating current and the greater the amount of heat produced in consequence. The cytoplasm in the bacterial endospores becomes more concentrated due to loss of water, and consequently the electrolytic substances in solution within the cells offer less resistance to the electric current than does the surrounding medium (milk). As a result, an instantaneous and marked increase in temperature within the cells themselves is effected. The heat thus created is probably sufficiently intense to cause the destruction of the spores.

The idea brought out in the above statement has been demonstrated in the laboratory by immersing an artificial cell, consisting of a parchment sac, filled with a 1.8 per cent. NaCl solution, between two carbon electrodes in a vessel containing a 0.9 per cent. salt solution. A sensitive thermometer was suspended in each solution, respectively, and, when the current was applied (110 v, A. C.) the temperature of the solution in the outer vessel at the end of 0, 10, 20, 30, 40, 50 and 60 seconds was, respectively, 21°, 26°, 31°, 39°, 57°, 76° and 86° C.; while in the parchment sac it was 21°, 28°, 37°, 48°, 62°, 80° and 88° C. The medium in the parchment sac contained the greater amount of free ions and, therefore, offered the least resistance to the current, and as a result more current flowed through the cell, and consequently more heat was generated.

A similar experiment was conducted in which the salt solutions both in the suspended cell and the surrounding medium were of equal concentration (0.9 per cent. NaCl), and a very heavy suspension of *Bacillus megatherium* spores was added to the inner or suspended cell. The temperature in the outer vessel at the end of 0, 10, 20, 30, 40, 50 and 60 seconds was, respectively, 21°, 25°, 31°, 37°, 48°, 62° and 78° C.; while in the parchment sac, containing spores in addition to the salt solution, it was 21°, 25°, 31°, 39°, 59°, 80° and 98° C. The data given from the above two experiments are representative of repeated tests.

The results of the first experiment showed that though the rise in temperature in the suspended cell was much more rapid than in the surrounding medium, the temperatures in both liquids quickly tended to become equal, and both reached the boiling point at about the same time. This was probably due to the fact that diffusion through the type of sac used was very rapid. The results obtained with the spores, however, showed that though the temperature rise was practically equal in both the inner and outer liquids for the first 30 seconds, the rate of increase became

[1] Journal Article No. 118 (M.S.) from the Michigan Agricultural Experiment Station.

[2] A. J. Galpi, Jr., and E. D. Devereux, "Effect of the Electropure Process and of the Holding Method of Treating Milk upon Bacterial Endospores," *Jour. Dairy Science*, 13, 368–371. 1930.

markedly greater thereafter. It is possible that this increase in heat in the suspended cell could have been brought about by "radiation" from the heated spores in the liquid. If this was the case, then there is reason to believe that the temperature within the spores was probably much higher than in the surrounding medium, which would aid in the destruction of the endospores. This point could be brought out more clearly if the combined volumes of the spores in suspension were greater in proportion to the suspending liquid. A more striking difference in temperature would undoubtedly be evident, due to the increase in radiated heat.

SUMMARY

The results of these experiments seem to indicate that the destruction of endospores by this electrical process is not entirely due to the heat created in the medium surrounding the endospores but also by another heat factor, namely, the heat generated within the endospores. Also, the temperature attained within the endospores is probably greater than that of the surrounding medium.

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DISSOCIATION OF CL. WELCHII

PLATING out pure cultures of *Cl. welchii* on suitable media has given rise to the development of two distinctly different types of colonies, the one a smooth hemispherical mound with sharply defined margins, the "S," the other a flat granular colony with an irregular or flagellated margin, the "R." Repeated fishing of colonies characteristic of the two types results in the development of pure strains of the two; in the case of the "S," the cultures usually show a few colonies with an "R"-like outgrowth even after many generations, the "R" types on the other hand become fixed much more readily; in the case of one culture, the "R," fished directly from the primary plate from an old laboratory culture containing both types, bred true for many generations

These two types present the usual morphological appearance and give the characteristic reactions of *Cl. welchii* so far as carbohydrate fermentations and stormy fermentation of milk are concerned. In fluids the two types appear strikingly different in their habit of growth. The "S" produces an even turbidity with little tendency to develop a deposit, while in the case of the "R" there is a heavy bottom growth and almost clear supernatant. With the latter type, after several cultural generations in broth, a faint turbidity frequently appears and on plating out such a turbid culture, some "S" colonies always develop which may be established as a pure strain by repeated fishing of characteristic colonies. Acid agglutination reactions and cataphoresis studies indicate the iso-electric point of "S" suspensions to be much more acid than that of the "R" type. Agglutinins specific for the two types are produced by the treatment of rabbits with washed suspensions.

There is also a marked contrast in the pathogenicity of the two types. Pigeons die in approximately four hours, following the introduction into the breast muscle of one cubic centimeter of twenty-four hour fluid cultures of the "S" type, while the same amounts of "R" cultures, grown in the same manner, have very little apparent effect.

The "S" types produced haemotoxin from ten to twenty times more potent than that produced by the "R," as measured by *in vitro* haemolysis of red cells, although both "S" and "R" haemotoxins are neutralized by stock *Cl. welchii* antitoxin. As might be expected, the "S" toxins, when introduced intravenously in suitable doses into experimental animals, result in a rapidly developing profound anemia, and blood films made during the course of the anemia show a marked degree of anisocytosis, similar to that shown in earlier papers by the use of toxin from undissociated cultures of *Cl. welchii.* The "R" toxins in the same dosage have little effect. When given in doses correspondingly large, taking the haemolytic titer as the criterion, a definite anemia is produced, though not so marked as that which follows injection of the "S" toxin nor is the anisocytosis so conspicuous.

It appears that *Cl. welchii* behaves as the many aerobic species of bacteria which have been studied from this angle. A detailed paper is in process of publication.

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